A method for producing identification marks on paper or board and a marked material made with the method

The invention involves a method for producing identification marks on layered paper or board made in a continuous web. In addition, the invention also concerns layered paper or board made with this method, containing identification marks.

Visible marks can be made on consumer packages at the packing phase, for the purpose of informing the consumer about the packaging date or the "consume by" date of the product. In addition, marks which may be partially or entirely invisible are used as product identifiers, which identifies the origin of the product and ensuring its authenticity.

Well-known package marking methods include ink printing, embossings and cuttings or perforations made in the packaging material by pressing or cutting. However, laser package marking is used increasingly. With this method, the marks are made with a laser beam without physically touching the packaging material or leaving printing ink or any other extra substance on the packaging.

With a laser beam, it is possible to affect fiber-based material, such as paper or board, in a number of ways. As is well-known, a laser beam burns through thin paper. To prevent this, US patent publication 6306493 presents a fine polymer additive to be mixed in with the paper to act as absorbent and char, thus leaving a dark, distinguishable mark on the paper. According to the knowledge and experience of the applicant, it is, however, possible to burn the surface fiber layer of the paper with a laser beam to produce a mark, without any through-burning of the paper and without the need to add polymer or other additives to the pulp, as described in the publication.

Other possible fiber-layer laser working methods are cutting the surface of the layer or engraving using an inert gas to prevent the burning of the material. The marks made in this manner are hollow on the surface of the fiber-layer, where no significant material color alteration takes place. A mark can also be produced by changing the structure of the fiber-layer by reacting one of its components with a laser beam or by vaporizing it. The mark can be detected so it can be used as an identifier.

A laser-marked paper or board similar to US patent 6306493 has been put forward for use as packaging material, labels or wrapping papers for various consumer

packages marked by targeting the laser beam on the surface of the material. The laser marking is thus essentially related to the packaging process of the products. US patent publication 5340628 describes a laser-marked layered packaging material where the paper base is introduced with a polymer layer of polyester or polypropylene, which the laser beam later penetrates, leaving a mark on the paper layer below. The material was designed for labels attached to product packages where the laser marks contain package-specific information about the product.

According to the publications mentioned earlier, known fiber-based laser-marked materials are meant mainly for making marks serving consumers in the product packaging phase. Their applicability is not the best possible to identifier marks to prove the authenticity of the product, i.e. where the marking is mainly intended to prevent or complicate product forgery. A forger who copies the product with the package naturally tries to produce the laser marks on the package.

The objective of the invention presented is to provide a solution by marking paper or board used particularly as packaging material with a suitable laser mark, which is significantly more difficult to forge. The starting point of the invention is that in the packaging phase instead of making marks on the ready-made package or the package being manufactured, the mark is included in the packaging material itself, in the paper or board, which is layer-structured. Characteristic for the method according to the invention is that the marks are made with a laser beam on a moving web form layer, subsequently overlaid with a second layer of material in such a way that the marks remain inside the layer-structure of the moving web.

With this invention, identification marks are produced in a moving web on an on-line principle with a paper or board machine or with a paper or board coating unit. The laser heads can be located, for example, in a stationary beam installed crosswise to the web, which would produce a suitably covering regular figure in the moving web. Any figure can be used as identification mark, for example, a logo or a trademark of the paper or board manufacturer or the product manufacturer, or, significantly, a mark specific to the product being packaged. As the identification remains inside the layer structure of the paper or board, it cannot be tampered with or easily reproduced by a forger. To succeed, the forger would need to copy the product and package including the packaging material, which, even if technically possible, would make the activity unprofitable.

The laser markings can be made by burning the surface of the fiber layer by using a low power density CO_2 laser beam. By using a CO_2 laser beam of higher power

density and an inert gas preventing oxidation hollows can be engraved by vaporizing material from the fiber layer. The hollow relief works as identification marks identified by a detector on raying.

The applications of the invention include a board containing two or more overlaid fiber layers. The marks are created on the surface of the web form fiber layer before the layers are joined together. At the joining stage, the fiber webs may still be moist, in which case the marks are made before the final drying of the joint web with a board machine, and are inseparably integrated into the final board. If the marks are hollows formed in the fiber layer, moist or elastic fiber layers overlaid fill the hollows in such a way that the board takes on an even thickness and density. If different materials are used for the layers, the marks formed by the hollows are still recognizable in the final board. If the materials differ in darkness and the hollows were made in the darker layer, the figures formed by the hollows can be seen (by raying) in the board as lighter than the surrounding area. Correspondingly the hollows made in the lighter layer show up as darker than their surroundings. Chemical and chemical/mechanical or mechanical pulps, and particularly unbleached pulps, such as brown kraft pulp, and bleached pulps, have these kinds of darkness or color differences sufficient for identification purposes.

In paper or board manufactured by the method used in the invention, the material layer placed on the fiber layer and marked online may be formed by a coating paste or glue layer, applied during the manufacturing process with a paper or board machine, or on a fiber layer, for example, by extruding the polymer coating to be joined. With a transparent polymer coating the identification marks can be left visible, for example, by burning, while at the same time they are protected against being tampered with by the coating. The identification marks and subsequent coating takes place, according to the invention, as a continuous process without interrupting the movement of the web.

With this method, products contain a paper or a board in the form of a layered web containing identification marks, and the paper or board is equipped with marks made by a laser beam that are embedded inside the layer structure of the web. A marked product such as this can be manufactured in large scale in a paper or board factory, from where it is delivered in rolls to a customer who then uses it for individual product packages. The material may be multi-layered board, coated paper or board or polymer-coated paper or board; and the marks may be hidden under the coating or a layer of fiber, where they can be detected by raying or with a detector, or the marks may be left visible under a transparent polymer coating.

As an example of the application of the invention, laser-marked packaging cartons may be made of a three-layered folded carton form having outer pulp layers of sulfate and the middle layer made of chemical-thermo-mechanic pulp (CTMP). In this carton the marks are burned darker in the interface of the sulfate and CTMP layers or the marks are hollows engraved in either layer, detectable due to differences in the composition of the pulp.

The invention is explained in more detail below with examples by reference to a drawing, depicting:

figure 1 the laser marking of a fiber material web and subsequent joining to another web to produce a layer-structured web format

figure 2 laser marking according to figure 1 and the joining of the webs, seen from the side

figure 3 marking of the web as a III-III intersection of figure 2

figure 4 the layer structure of a laser-marked carton using the invention

figure 5 the layer structure of another laser-marked carton

figure 6 the layer structure of a third laser-marked carton.

Figures 1-3 show the fiber material web 1; its route has been introduced with a beam 2 in a crosswise direction to the web. From the laser heads 3 beside the beam, identifying marks 5 are produced on the surface of the web with the aligned laser beams 4. The marks may be any figure 5, such as a company or product name, logo or trademark, and in the case of Figure 1 they form crosswise lines spaced at even intervals on the web. The web should include enough coverage for the marks 5 in such a way that there are enough marks for each sheet or packaging preform later to be separated from the layer-structured web.

The laser heads 3 in Figures 2 and 3 may comprise low-density CO_2 laser sources that lightly burn the surface of the web 1 in such a way that the identification marks 5 are darker areas caused by the oxidation of the fiber material. Alternatively, with higher density CO_2 laser heads 3 and inert gas directed simultaneously, the surface of the web 1 can be engraved with hollows as identification marks, based on vaporizing the material. It is also possible with laser beams 4 to cause the reaction or vaporization of a component of the web material selectively from a certain depth

of the web or along the entire thickness of the web in such a way that its density or composition is changed at the place of marking.

After the marking phase, as the web 1 continues its movement, another moving material web 6 is brought against it, as shown in Figures 1 and 2, in such a way that together the webs form a layer-structured, web format 7. Wherever necessary, adhesives can be used to join the webs 1 and 6. The product 7 delivered as a continuous web is rolled (not presented) and after further converting phases – if any - it is delivered in the form of a roll, sheets or preform to be used as individual product packages containing identification marks 5.

Fiber material can also be used as the second web 6 to be joined to the fiber material web 1 equipped with marks 5. In this case, multilayered board is produced as the web form product 7. In the schematic figures 1 and 2, only two layers 1 and 6 are presented, but boards may have more layers, and if needed, identification marks 5 can be produced on the extra fiber layers or on the opposite sides of the same layer.

The second material layer to be introduced on the marked fiber material web 1 may also comprise, for example, a polymer sheeting or a single- or multi-layered extruded polymer coating to be laminated with the web. It is possible to laser-mark the fiber material web 1 with a paper or board machine, in which case, in the next phase the web is introduced with a coating paste covering the identification marks.

When another fiber material web 6 is brought onto the fiber marked material web 1, the identification marks 5 remain hidden inside the obtained layer-structured board 7 from which the marks however can be detected with a suitable device. If the layers are thin enough, the marks 5 made by burning are visible to the naked eye when the material is held up against the light. If the marked fiber material web 1 is equipped with a transparent polymer coating, the burned marks 5 can be seen through the polymer layer.

Figure 4 shows layer-structured products made using the invention: a three-layer board 7, in which the middle layer 1 fiber material differs from the fiber material of outer layers 6 and 8. The material used for the middle layer could be, for example, CTMP and the outer layers 6 and 8 could be, for example, bleached sulfate pulp. The identification marks inside the layer-structure are oxidations in the surface of the middle layer 1. The laser marking of the middle layer 1 and join to the outer layer 6 covering the marks 5 take place as per Figures 1-3. The second outer layer 8

may have been joined to the middle layer 1 before the marking phase or after the phases described in the figures 1-3.

The application of the invention according to Figure 5 differs from the one presented in Figure 4: the marks in board 7 are hollows 5' formed on the surface of the middle layer 1. If the marking was made with a board machine while the fiber material layers 1 and 6 were still moist, the hollows 5' fill with the material of the outer layer 6 in such a way that the board 7 rendered as the final product is essentially uniform in thickness and density. When the materials of middle and outer layers 1, 6 differ, the marks formed by the hollows 5' are still detectable using a detector. For example, in one case, the CTMP may be darker than the sulfate pulp, shown by raying as lighter than the surrounding area.

In the schematic 6, the identification marks 5''are points on the middle layer 1 where the material has been treated with a laser beam throughout the entire thickness, for example, by changing the material color or density. The change could be based, for example, on the mixing component, such as polymer particles oxidized by the laser beam, or a mixing component vaporized by laser beam. Alternatively, the laser beam could be used to affect only a part of the thickness of layer 1.

For professionals, clearly, many other examples of the invention could be used. The relevant claims are set out below: